REMARKS

Status of Claims

Claims 1 – 30 were original in the application. Claims 1, 4, 5, 7, 8, 16, 17, 19, 20, 22, 23, and 29 have been amended. Claims 1- 30 are submitted for examination on the merits.

Rejection Pursuant to 35 USC 112

Responsive amendments have been made to the claims in each instance except as noted as follows.

In regard to claims 2, 15, 17 and 30 the Examiner contends that negative limitation of the functional phrasing "without interfering with the measured precession of the slave mass" is structurally indefinite. First, a negative functional limitation is as definite as a positive functional limitation[1]. Second, this phrase is part of the statutory functional definition under 35 USC 112, paragraph 6, of control means in claim 2 and the step of maintaining oscillation of the slave mass by means of control of the sense and drive electrodes in claim 17. Functional definition is expressly statutorily permitted[2].

In regard to claims 14 and 29, claim 14 and 29 explain how in particular the gyroscope maintains the slave mass at the constant energy state as set forth in claims

---

[1] In re Wakefield, 422 F.2d. 897, 164 USPQ 636 (CCPA 1970); In re Barr, 444 F.2d 588, 170 USPQ 330, 337 (CCPA 1971); MPEP 2173.05(i)
[2] **35 U.S.C. 112 Specification.**
. . .
An element in a claim for a combination may be expressed as a **means or step for performing a specified function without the recital of structure, material, or acts in support thereof**, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

13 and 28 respectively.

Rejection Pursuant to 35 USC 103(a)

Claims 1 - 30 were rejected as being obvious over **Shkel** US Patent 6481285 in view of **Dyck** US Patent 6393913.

The Examiner's Position vis a vis Shkel

The Examiner cited **Shkel** as showing an angle measuring gyroscope having a substrate having a first surface, a movable mass coupled to the substrate, two sets of orthogonal drive electrodes coupled to the mass and defined in a plane above the substrate, and two sets of orthogonal sense electrodes coupled to the mass and defined in the same plane as the drive electrodes. Control means was cited as being coupled to the sense electrodes and the drive electrodes to drive the mass at a constant amplitude at a first resonant frequency, to generate an output position and velocity signal of the mass, and to feed back the output position and velocity signal to generate a control signal applied to drive the mass at a constant energy state. The Examiner admitted that **Shkel** lacks a separate drive mass and slave mass, and the details of their relationship, because in **Shkel** the drive and slave masses are the same mass.

The Examiner's Position vis a vis Dyck

The Examiner cited **Dyck** as teaching use of a separate drive mass and slave mass. The Examiner contends that the drive mass is driven in a linear region, while the motion of the drive mass is coupled to the slave mass to amplify the motion of the drive

mass to the slave mass to increase sensitivity. The Examiner continues by stating that the drive mass can be in a window in the slave mass so that the slave mass surrounds the drive mass, or the positions can be reversed. Drive electrodes 26 are positioned in a window of the drive mass. The extent of motion of the slave mass can be larger than the extent of motion of the drive mass upon actuation of the first mass. The actuating voltage can be reduced while still providing an increased motion of the slave mass compared to the motion of the drive mass. The Examiner contends that this provides an increased sensitivity for position sensing of the device while reducing an electrical noise level of the device. Several modes of operation are taught, including a resonant mode at a first eigenfrequency where maximum deflection peak occurs in the slave mass, and an antiresonant mode, where greatest dynamic amplification is achieved.

The Examiner concludes that It would have been obvious to modify the single drive/slave mass structure of **Shkel** with the dual mass structure of **Dyck** to increase the sensitivity of the device of **Shkel** while reducing the drive requirements and noise, where such motivation is expressly indicated in **Dyck**. The Examiner continues by concluding that it would have been obvious to associate the drive electrodes with the drive mass and the sense electrodes with the same mass. The Examiner contends it would be obvious to space the electrodes accordingly so that greater spacing would be required for the sense electrodes, since the sense mass requires higher deflection amplitudes. The Examiner contends that it would have been further obvious to place the sense electrodes in a window in the sense mass in the same manner shown in **Dyck** with respect to the drive mass, to provide a more compact structure, as taught in **Dyck**.

Response

No previous theoretical basis existed for the use of a dual mass structure as an angle measuring device and the existing theory on single mass angle measuring sensors is not obviously extendible to a dual mass structure.

Within the context of an angle measuring device, the claimed device is geometrically different because it has a different electrode structure and different suspension coupling system between the masses. The claimed invention is functionally different from the technology proposed by **Dyck,** because the claimed device can be used as an angle measuring device where **Dyck's** cannot. Any general functional similarities between the claimed device and **Dyck's**, such as the use of dual mass structure and use of parallel plate drives, also share the same functional similarities to prior art taught before the publication of **Dyck's** work.

What is claimed is the use of a dual mass structure as an angle measuring gyroscope, which is not an obvious extension of **Shkel**[3]. The theoretical basis for proving that an isotropic single mass oscillator can be used as an angle measuring device is not trivial and requires strong analytical formalization. Such a foundation for a single mass device was explored decades ago and first realized on a micro scale using a unique configuration by Shkel in his publications and in **Shkel** U.S. patent 6,481,285.

However, a coupled dual mass system is a completely different dynamic system and it is **not** obvious that such a system is even capable of making angle measurements. With the complex interaction of the coupled motion of the masses, it would beg the question, "shouldn't this alone destroy the precession (angle measuring) capabilities?" as there is no existing theoretical basis that demonstrates otherwise; that

a dual mass system precesses under rotation. Nowhere in 6,481,285 are any theoretical foundations presented that include the possibility of using additional masses.

In the present application, we provide a theoretical basis for such a sensor and the specialized control scheme necessary for its operation, something which has never been presented before to our knowledge and as such, this makes the proposed sensor novel. It is also worth noting that it was not obvious to Dr. Shkel, as co-inventor of this new patent and inventor of the original 6,481,285 patent, that a dual mass angle measuring gyroscope could be used as an angle measuring device and that it required rigorous analytical and numerical work to prove that this device would in fact be capable of angle measurements, and this only under a novel, specialized feedback control architecture as described in the application.

The claimed invention is not a simple extension of **Dyck**, which describes a general dual mass system driven using parallel plate actuation where the device is driven along a single direction. The use of dual mass structures for amplification is not a new concept and has existed for decades and is the source of numerous books and publications, which also teach various modes of operation and more specifically on the micro scale as dual mass gyroscopes. The use of parallel plate actuation is not new either and has existed in resonator systems for decades as well, which also teach effect of undesirable nonlinearities in high amplitudes of motion and the benefits of small amplitudes of motion to preserve linearity, sensitivity, and noise performance. Thus, any realization of a general parallel plate resonator is an obvious extension of these prior technologies. The resonator in **Dyck** differentiates from these proposed concepts only through novelty in geometric configuration with restrictions where a dual mass is

---

[3] Note the current inventors are also the inventors of **Shkel**.

driven ***using a single set of parallel plate electrodes along a single direction, with a single electrode beneath the sense mass to determine response to external applied forces*** (this is not an actuation electrode). Further, ***the suspension system in Dyck only allows one degree of freedom in drive***.

The claimed design is a dual mass structure where both masses operate along two directions simultaneously, allowing it to operate as an angle measuring device, rather than actuation along a single direction. Geometrically, we require two sets of differential orthogonal parallel plate pairs for both drive and sense as well as a coupled two degree of freedom suspension system. **Dyck** only uses differential parallel plate electrodes for the drive mass and the suspension system only allows for actuation along a single direction. In the claimed device we are sensing is along two orthogonal directions rather than one. The device proposed in **Dyck** uses a single sense electrode and could never be used as an angle measuring sensor. Thus, our claimed design is structurally and operationally different then the structure taught by **Dyck**.

Turn to claim 1. What is claimed is an angle measuring gyroscope which measures angular position arising from angular motion in which the drive mass and slave mass are both movable in two orthogonal directions, and there are two sets of orthogonal drive electrodes and two sets of orthogonal sense electrodes both in two orthogonal directions. The drive mass and slave mass are coupled together by a two-degree of freedom suspension. These features are not combined in either **Shkel** or **Dyck** nor is it suggested or motivated by these two references that the complex interaction of the coupled motion of the masses allows a dual mass system to precess

under rotation, or what would have to be done architecturally in a system in order to obtain a useful signal which is a measure of the angular position.

Applicant respectfully requests advancement of the claims to allowance.

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on ~~February 17, 2005~~ by Feb. ~~23~~ 24, 2005 Signature ~~February 17, 2005~~ February ~~23~~ 24, 2005	Respectfully submitted, Daniel L. Dawes Registration No. 27,123 Myers Dawes Andras & Sherman LLP 19900 MacArthur Blvd., 11th Floor Irvine, CA 92612 (949) 223-9600